AMENDMENTS TO THE CLAIMS

Please cancel claims 3-7, 36-39 and 42 without prejudice.

Please amend claims 1, 2, 17, 19-24, 40, 41, 43-52 as follows.

Please add new claims 55-66 as follows.

1. (Currently Amended) An optical tuning apparatus, comprising:

~~(a)~~ a first tunable wavelength selection element ~~positioned in a light beam and having~~ configured to define a first plurality of tunable transmission peaks separated by a first adjustable free spectral range; ~~and~~

~~(b)~~ a second tunable wavelength selection element ~~positioned in a light beam and having~~ configured to define a second plurality of tunable transmission peaks separated by a second adjustable free spectral range; and

~~(c) said first and second tunable wavelength selection elements configured to define a joint free spectral range operable to tune said light beam~~

a controller, operatively coupled to each of the first and second tunable wavelength selection elements, to adjust the first and second free spectral ranges to produce at least one tunable joint transmission peak, wherein each of said at least one tunable joint transmission peak comprises a respective pair of transmission peaks, one from each of the first and second plurality of tunable transmission peaks, that are aligned, and said at least one tunable transmission peak is tuned using a Vernier tuning effect.

2. (Currently Amended) The apparatus of claim 1, wherein said ~~first and second tunable wavelength selection elements define a~~ at least one joint transmission peak ~~that~~ is

adjustable according to tuning of said first and second tunable wavelength selection elements.

3-7. (Cancelled)

8. (Original) The apparatus of claim 1, wherein said first and second tunable wavelength selection elements comprise at least one etalon.

9. (Original) The apparatus of claim 1, wherein said first and second tunable wavelength selection elements comprise at least one grating.

10. (Original) The apparatus of claim 1, wherein said first and second tunable wavelength selection elements comprise first and second etalons.

11. (Original) The apparatus of claim 10, wherein at least one of said first and second etalons is thermo-optically tunable.

12. (Original) The apparatus of claim 10, wherein at least one of said first and second etalons is electro-optically tunable.

13. (Original) The apparatus of claim 10, wherein at least one of said first and second etalons is angle tuned.

14. (Original) The apparatus of claim 10, wherein at least one of said etalons comprises a semiconductor material.

15. (Original) The apparatus of claim 10, wherein at least one of said etalons includes first and second surfaces, each said surface having at least one quarter wave dielectric pair layer thereon.

16. (Original) The apparatus of claim 14, wherein said etalon includes a thermal control element integrated thereon.

17. (Currently amended) The apparatus of claim 11, wherein said ~~etalon is operatively coupled to~~ controller comprises a thermal controller.

18. (Original) The apparatus of claim 11, wherein said etalon is operatively coupled to a thermal reservoir.

19. (Currently amended) A ~~tuning~~ laser apparatus ~~for a light beam~~, comprising

a base;

a gain medium, operatively coupled to the base, to emit a light beam in response to an electric input;

~~(a)~~ a first tunable wavelength selection element operatively coupled to the base and positioned in ~~said~~ the light beam, configured to define a first plurality of tunable transmission peaks having a first adjustable free spectral range;

~~(b)~~ a second tunable wavelength selection element operatively coupled to the base and positioned in ~~said~~ the light beam, configured to define a second plurality of tunable transmission peaks having a second adjustable free spectral range; and

~~(c) said first and second pluralities of transmission peaks defining a single joint transmission peak within a selected wavelength range; and~~

~~(d) said first and second tunable wavelength selection elements operable to adjust said joint transmission peak according to adjustment of said first and second tunable elements~~

a controller, operatively coupled to each of the first and second tunable wavelength selection elements, to tune a wavelength of an optical output produced by the apparatus by concurrently adjusting the first and second free spectral ranges of the first and second tunable wavelength selection elements to define a single joint transmission peak within a selectable wavelength range and adjustable in phase according to tuning of said first and second tunable wavelength selections elements.

20. (Currently amended) The apparatus of claim 19, ~~further comprising a~~ wherein the gain medium comprises a laser diode having first and second facets defining an internal cavity having a free spectral range and emitting ~~said~~ the light beam from the first facet~~, said gain medium having a free spectral range~~.

21. (Currently amended) The apparatus of claim 20, further comprising a reflective element positioned in said light beam after the first and second tunable wavelength selection elements, ~~said~~ the reflective element and the second facet of ~~said~~ the gain medium defining an external cavity laser.

22. (Currently amended) The apparatus of claim 20, wherein ~~said~~ the first tunable wavelength selection element has a first free spectral range that is approximately equal to a multiple of the ~~said gain medium~~ free spectral range of the gain medium.

23. (Currently amended) The apparatus of claim 20, wherein ~~said~~ the second tunable wavelength selection element has a second free spectral range that is approximately equal to a multiple of the ~~said gain medium~~ free spectral range of the gain medium.

24. (Currently amended) The apparatus of claim 20, wherein ~~said joint free spectral range~~ the selectable wavelength range is at least as great as a gain bandwidth of said gain medium.

25. (Original) The apparatus of claim 19, wherein said first and second tunable wavelength selection elements comprise at least one etalon.

26. (Original) The apparatus of claim 19, wherein said first and second tunable wavelength selection elements comprise at least one grating.

27. (Original) The apparatus of claim 19, wherein said first and second tunable wavelength selection elements comprise first and second tunable etalons.

28. (Original) The apparatus of claim 27, wherein at least one of said first and second tunable etalons is thermo-optically tunable.

29. (Original) The apparatus of claim 27, wherein at least one of said first and second tunable etalons is electro-optically tunable.

30. (Original) The apparatus of claim 27, wherein at least one of said first and second tunable etalons is angle tuned.

31. (Original) The apparatus of claim 27, wherein at least one of said tunable etalons comprises a semiconductor material.

32. (Original) The apparatus of claim 27, wherein at least one of said tunable etalons includes first and second surfaces, each said surface having at least one quarter wave dielectric pair layer thereon.

33. (Original) The apparatus of claim 31, wherein said tunable etalon includes a thermal control element integrated thereon.

34. (Original) The apparatus of claim 28, wherein said tunable etalon is operatively coupled to a thermal controller.

35. (Original) The apparatus of claim 28, wherein said tunable etalon is operatively coupled to a thermal reservoir.

36-39. (Cancelled)

40. (Currently amended) A method for tuning a light beam, comprising:

~~(a)~~ positioning a first tunable wavelength selection element in ~~said~~ the light beam, ~~said~~ the first tunable wavelength selection element configured to define a first plurality of tunable transmission peaks having a first adjustable free spectral range;

~~(b)~~ positioning a second tunable wavelength selection element in ~~said~~ the light beam, ~~said~~ the second tunable wavelength selection element configured to define a second plurality of tunable transmission peaks having a second adjustable free spectral range; and

~~(c) defining a joint free spectral range from said first and second free spectral ranges; and~~

~~(d) adjusting said joint free spectral range by tuning said first and second tunable wavelength selection elements~~

concurrently tuning the first and second tunable wavelength selection elements to align one of the first plurality of transmission peaks with one of the second plurality of transmission peaks via a Vernier tuning effect to define a single joint transmission peak.

41. (Currently amended) The method of claim 40, wherein ~~said defining said joint free spectral range comprises~~ the first and second adjustable free spectral ranges are adjusted via tuning of the first and second wavelength tunable elements to ~~defining~~ define a single joint transmission peak within a selected wavelength range.

42. (Cancelled)

43. (Currently amended) The method of claim 40, further comprising:

~~(a)~~ providing a gain medium having first and second facets;

~~(b)~~ emitting ~~said~~ the light beam from ~~said~~ the first facet; and

~~(c)~~ positioning a reflective element in ~~said~~ the light beam after ~~said~~ the first and second tunable wavelength selection elements, ~~said~~ the reflective element and ~~said~~ the second facet of ~~said~~ the gain medium defining an external laser cavity.

44. (Currently amended) The method of claim 43, wherein the first and second tunable wavelength selection elements are tuned to define a plurality of joint transmission peaks having a ~~said~~ joint free spectral range that is at least as great as a gain bandwidth of ~~said~~ the gain medium.

45. (Currently amended) The method of claim 43, wherein ~~said~~ the first free spectral range is approximately equal to a multiple of a free spectral range of ~~said~~ the gain medium.

46. (Currently amended) The method of claim 45, wherein ~~said~~ the second free spectral range is approximately equal to a multiple of ~~said~~ the gain medium free spectral range.

47. (Currently amended) The method of claim 40, wherein:

~~(a)~~ ~~said~~ positioning ~~said~~ the first tunable wavelength selection element comprises positioning a first tunable etalon in ~~said~~ the light beam; and

~~(b)~~ ~~said~~ positioning ~~said~~ the second tunable wavelength selection element comprises positioning a second tunable etalon in ~~said~~ the light beam.

48. (Currently amended) The method of claim 47, wherein ~~said adjusting said join free spectral range~~ concurrently tuning the first and second tunable wavelength selection elements comprises thermo-optically tuning ~~said~~ the first and second tunable etalons.

49. (Currently amended) The method of claim 48, wherein said thermo-optically tuning comprises;

~~(a)~~ thermally adjusting a refractive index of ~~said~~ the first tunable etalon; and

~~(b)~~ thermally adjusting a refractive index of ~~said~~ the second tunable etalon.

50. (Currently amended) The method of claim 49, wherein said thermo-optically tuning further comprises:

~~(a)~~ thermally adjusting a physical thickness of ~~said~~ the first tunable etalon; and

~~(b)~~ thermally adjusting a physical thickness of ~~said~~ the second tunable etalon.

51. (Currently amended) A method for laser operation, comprising:

~~(a)~~ emitting a light beam from a first facet of a gain medium:

~~(b)~~ positioning an end reflector in ~~said~~ the light beam, ~~said~~ the end reflector and a second facet of ~~said~~ the gain medium defining an external laser cavity;

~~(c)~~ positioning first and second tunable wavelength selection elements in ~~said~~ the light beam ~~before said~~ between the first facet of the gain medium and the end reflector, ~~said~~ the first and second tunable wavelength selection elements respectively configured to define first and second pluralities of tunable transmission peaks having respective first and second free spectral ranges;

~~(d)~~ defining a single joint transmission peak from said first and second pluralities of transmission peaks; and

~~(e)~~ adjusting the joint transmission peak by concurrently tuning the first and second tunable wavelength selection elements.

52. (Currently amended) A laser apparatus comprising:

~~(a)~~ gain means for emitting a light beam; and

~~(b)~~ first and second tunable means for wavelength selection of ~~said~~ the light beam ~~by Vernier effect~~, each configured to define a respective plurality of transmission peaks and having respective tunable free spectral ranges; and

control means for tuning the first and second tunable means for wavelength selection to produce a tunable joint transmission peak by aligning one of the transmission peaks for each of the first and second plurality of transmission peaks using a Vernier tuning effect.

53. (Original) The apparatus of claim 52, further comprising means for defining an external laser cavity, said first and second tuning means positioned in said external laser cavity.

54. (Original) The apparatus of claim 52, wherein said first and second tunable means comprise first and second thermo-optic etalon means for wavelength selection of said light beam.

55. (New) The optical tuning apparatus of claim 1, further comprising a third tunable wavelength selection element configured to define a tunable pass band.

56. (New) The optical tuning apparatus of claim 1, wherein the first free spectral range (FSR_1) is related to the second free spectral range (FSR_2) by the equation:

$$FSR_1 \approx (M/M+N)(FSR_2)$$

wherein M is the total number of tunable wavelengths within a selected wavelength range, and N is a non-integer or integer number that is selectable.

57. (New) The optical tuning apparatus of claim 1, wherein each of the first and second adjustable free spectral ranges are greater that a wavelength channel spacing in a communication grid to which the apparatus may be tuned.

58. (New) The optical tuning apparatus of claim 1, wherein the apparatus enables continuous, selective wavelength tuning over a wide wavelength range in a manner that is independent of a fixed, pre-determined wavelength grid.

59. (New) The laser apparatus of claim 19, further comprising a third tunable wavelength selection element operatively coupled to the base and positioned in the light beam, configured to define a tunable pass band.

60. (New) The laser apparatus of claim 19, wherein the first free spectral range (FSR_1) is related to the second free spectral range (FSR_2) by the equation:

$$FSR_1 \approx (M/M+N)(FSR_2)$$

wherein M is the total number of tunable wavelengths within a selected wavelength range, and N is a non-integer or integer number that is selectable.

61. (New) The laser apparatus of claim 19, wherein each of the first and second adjustable free spectral ranges are greater that a wavelength channel spacing in a communication grid to which the apparatus may be tuned.

62. (New) The laser apparatus of claim 1, wherein the apparatus enables continuous, selective wavelength tuning over a wide wavelength range in a manner that is independent of a fixed, pre-determined wavelength grid.

63. (New) A laser apparatus, comprising

a base;

an end reflector, operatively coupled to the base;

a gain medium, operatively coupled to the base, having a first facet from which a light beam is emitted in response to an electric input and a second facet opposite the first facet, the second facet and the reflector defining an external laser cavity having a first adjustable free spectral range and providing a plurality of lasing modes having a first plurality of transmission peaks; and

a tunable wavelength selection element operatively coupled to the base and positioned between the first facet and the reflector, configured to define a second plurality of tunable transmission peaks having a second adjustable free spectral range,

wherein the first adjustable free spectral range is related to the second adjustable free spectral range such that the first and second plurality of transmission peaks may be adjusted to generate a tunable joint transmission peak via a Vernier tuning effect.

64. (New) The laser apparatus of claim 64, wherein the tunable wavelength selection element comprises an etalon.

65. (New) The laser apparatus of claim 64, wherein the first free spectral range (FSR_1) is related to the second free spectral range (FSR_2) by the equation:

$$K(FSR_2) \approx (M/M+N)(FSR_1)$$

wherein K is a rational fraction, M is the total number of tunable wavelengths within a selected wavelength range, and N is a non-integer or integer number that is selectable.

66. (New) The laser apparatus of claim 64, wherein the tunable wavelength selection element comprises a wedge-shaped etalon that is positioned via a micro-electro-mechanical systems (MEMS) actuator.